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THE STUDY OF EMBRYOLOGY.

An Introduction to the Study of Embryology. By Prof. A. C. Haddon, M.A. (London: C. Griffin and Co., 1887.)

THE publication of this volume supplies a long-felt want. Many will remember the pleasure with which the first appearance of an English volume solely devoted to embryology was hailed. But there was a good deal of the "lively anticipation of future favours" in the gratitude with which the public received Part I. of the "Embryology" by Foster and Balfour. The first edition of this text-book contained, it will be remembered, a clearly written, well illustrated account of what was then known of the embryology of the chick. Although the details were far in advance of anything previously published on the subject in our language, yet the explanations were so clear and the style so lucid that the book was in every way suitable for the beginner. The public was informed, in the introduction, that the work was to be extended so that it would become a text-book of general embryology. Although this promise was more than fulfilled on the appearance of Balfour's classical work, the young morphologist was to a certain extent the loser by the immense benefit thus conferred upon the more advanced student. The second edition of the former book brought the account of the development of the chick up to date, and a comparatively short description of the essential features of embryological development in Mammalia was added, but the work still remains an enlarged Part I. But in the meantime the immense and ever-increasing development of invertebrate embryology, and the magnitude of the theoretical considerations raised by its advance, rendered it more necessary than ever that the beginner should be in possession of some introduction to this part of the subject; and that the student whom time and opportunity prevented from mastering Balfour's great work should, nevertheless, be permitted to gain some insight into the subject as a whole.

Both these conditions are fulfilled, and corresponding benefits will be conferred upon morphological teaching, by the publication of Prof. Haddon's text-book. In one respect, indeed, it appears to be probable that the "Embryology" of Foster and Balfour will always remain pre-eminent as a preliminary text-book for the young embryologist. The limited scope of that work renders possible a comparatively detailed description of the growth and arrangement of the embryonic membranes and appendages, so that the relative positions of these to each other, to the embryo, and to the yolk-sac, are brought before the student with a clearness and force which could not be attained in a more condensed statement. And the great difficulty with which this part of the subject is grasped by the beginner is apt to be undervalued by the advanced student and by the teacher. Again, the selection of a single type for detailed description renders possible and indeed suggests that the succeeding stages of development should be described after the manner of a diary; and while this method strongly impresses the imagination of the reader, it gives continuity as well as reality to the shifting scenes of embryonic development. It is also probable that such a method, with its constantly repeated recapitulations, and references to events which have been previously described, must afford to the memory an assistance which cannot be given by any other system. Of course the full development of this method is totally impracticable in a volume which deals with general embryology, and the subject is not at present in a condition such that it could be adequately represented by the selection of a few types for detailed description. A book which treats of the development of those mature organisms which are usually selected as types of the morphological series is much to be desired and would be extremely useful, but in the present state of embryological knowledge it is doubtful whether such a volume would represent general embryology as completely as general morphology is represented by the types themselves.

For the reasons given above, an ideal course of embryology will begin wtth Foster and Balfour, continue with Haddon, and end, as far as text-books are concerned, with Balfour. The complete mastery in the first-named work of a single easily accessible and readily investigated type, of considerable complexity and difficulty, will enable the student to grasp the shorter descriptions in Prof. Haddon's volume of all important embryological discoveries hitherto made. Finally, a rapid survey of general embryology being thus gained, the student will pass to the longer descriptions and further details of Balfour's classical work. A course of embryological teaching so complete as this, or so well suited to the needs of the student, does not exist in any other language.

It may be objected that in any such succession of text-books there must be a great deal of waste, from the description of the same developmental histories in rather different language. For the advanced student or the investigator the objection is valid, but I believe that every experienced teacher will agree in the opinion that the young student—for whom alone such a course is necessary—gains immensely by this very fact, and learns far more by reading a second text-book which puts the same facts in a slightly different way, than by reading the first text-book a second time.

It is very high praise of Prof. Haddon's volume to place it in the middle position of such a series. It is well and clearly written, while the adoption of smaller type for theoretical questions or less important details, is a great benefit to the beginner. The figures are drawn so that the primary layers and the organs derived from them can be respectively tinted in uniform colours throughout the book. While great additional clearness will be thus conferred, the student will gain much during the process of colouring. The illustrations are very numerous, and although many of them are roughly executed, and open to exception from an artistic point of view, their meaning is sufficiently clear. In the vast preponderance of the representations of sections among the illustrations, the work only follows the example of all books on the subject in all languages, but it is to be doubted whether the course of the young student is not somewhat impeded by this universal custom. There is no doubt that, as Prof. Weismann remarked to me the other day, the art of section-cutting is a weapon for morphological research

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equal in importance to the discovery of the microscope itself. And embryology, far more than any other department of morphology, depends upon this art; indeed, the study may be almost said to date from the introduction of this method of inquiry. Hence there is a strong bias in favour of representing structures in section; and in original papers and advanced treatises this custom is not to be deplored, for the reader knows exactly what is meant by the figures. But even in such works I think that the reader, and the author also, would benefit by the introduction of a few additional illustrations representing the organism, organ, or structure, as a solid object. But there can hardly be two opinions on this subject in the case of an introductory text-book. The beginner cannot readily or correctly reconstruct in imagination the solid structure from a representation of a section, and he must infallibly lose considerably in time by the prevalent custom of representing in only two dimensions objects which really exist in three. Long descriptions might be curtailed, and great additional clearness conferred by the frequent illustration of solid objects, out of which a small portion is represented as cut, on one side only, so as to show the internal structure. But this necessity is not fully recognized in any embryological text-book, although some attempt is made to deal with it in this and in other works. It is to be hoped that in future editions considerable attention may be paid to this mode of illustration, which will be more than repaid by the advantage conferred upon the young student.

In conclusion, the author seems to have included everything of importance in his subject up to the date at which the book was written; so that many important discoveries or theories are described which are necessarily absent from Balfour's work. When from the necessities of space these are only briefly touched upon, the reference to the original papers is to be found in Appendix B., containing a bibliography of recently published works on embryology Hence there is reason to hope that the volume may be found useful to the student who is familiar with Balfour's work.

E. B. P.

SOME MATHEMATICAL BOOKS.

The Conic Sections, with Solutions of Questions in London University and other Examination Papers. By G. Heppel, M.A. (London: Baillière, Tindall, and Cox, 1887.)

A New Mode of Geometrical Demonstration, with Examples showing its Application to Lines and Angles, Surfaces, and the Products of Three or more Straight Lines, &c. By D. Maver. (Aberdeen: A. Brown, 1887.)

Easy Lessons in the Differential Calculus: indicating from the Outset the Utility of the Processes called Differentiation and Integration. By R. A. Proctor. (London: Longmans, 1887.)

First Steps in Geometry: a Series of Hints for the Solution of Geometrical Problems, with Notes on Euclid, useful working Propositions, and many Examples. By R. A. Proctor. (London: Longmans, 1887.)

MR. HEPPEL'S little hand-book is not a complete treatise on elementary analytical geometry as usually presented to junior students, but it is a sequel to a previous small work in the same series ("Students' Aid Series"), "On the Geometry of the Straight Line and Circle." The object aimed at in the two works is to fully equip readers for the B.A. and B.Sc. examinations of the London University and similar examinations. Hence a limited portion only is discussed, viz. the equations to the conics; tangents, polars, normals, and curvature; sections of a cone, harmonic pencils, and miscellaneous theorems. Though Mr. Heppel has treated his subject concisely, he has not done his work in a perfunctory manner, for there is much originality exhibited in his mode of treatment, and he has discussed the general equation, not only for rectangular axes, but generally, in a very clear manner. If we mistake not, this clear exposition of a somewhat difficult part of the subject—difficult, that is, to junior students—is the outcome of some years' experience in tuition. In an appendix are given "hints to students" founded on this experience, and solutions to questions, illustrative of the text, which have been taken from the London University papers. There are a few errors in the printing, but they are not of a character to seriously inconvenience the student. We could have wished for a larger page, for then more justice would have been done to the author in the presentment of some of the formulæ. A student who carefully reads the text and transfers the formulæ for the separate conics to larger pages, ought to require no other text-book than this small one for the examinations named above.

Mr. Maver claims for his method the recommendation that it is new. One can hardly expect such to be the case, but we certainly do not remember to have come across it as here applied. The nearest approximation we can lay hands upon is the method of parallel transformation, given in Petersen's "Methods and Theories for the Solution of Problems of Geometrical Constructions" (pp. 46–47); but Mr. Maver has worked out the idea at considerable length and in an elegant manner. An illustration from the principles and from the body of the work will sufficiently explain the scope of the method. "Let AB and CD be two parallel straight lines, and AC, GK, and GM any lines whatever drawn from the line AB to the line CD. If these lines, AC, GK, GM, move in the direction of the parallels AB, CD, so that $CF = KL = MD$, then we have the space $CE = KB = GD$ (Euc. i. 36). Let the space CE be represented by $s\mathrm{AC}$, which may be read space generated by AC, and so on; then $s\mathrm{AC} = s\mathrm{GK} = s\mathrm{GM}$." Assuming results which readily flow from the above and which are given in the "Principles," let us now take Example II. The sides AB, BC of a triangle are bisected by CE, AF, cutting in G, to prove $CG = 2EG$, $AG = 2FG$; and if BG produced cuts AC in D, then $AD = CD$. "Let AF be the direction of motion, then $s\mathrm{CG} = s\mathrm{CF} = s\mathrm{BF} = s\mathrm{BA} = 2s\mathrm{EA} = 2s\mathrm{EG}$; $\therefore$ since $s\mathrm{CG} = 2s\mathrm{EG}$, $CG = 2EG$. In the same way $AG = 2FG$. Again, if DB be the direction of the motion we have $s\mathrm{AD} = s\mathrm{AB} = 2s\mathrm{EB} = 2s\mathrm{EG} = s\mathrm{CG} = s\mathrm{CD}$; $\therefore$ since $s\mathrm{AD} = s\mathrm{CD}$, $AD = CD$." There are five chapters, viz. one, containing the principles; two, applications to lines and angles; three, to squares and rectangles; four, the products of three or more straight lines; five, to lines that are in the same straight line. In an appendix the author "proves Euc. i. 36

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